Flavor and Storage Stability of Dehydrated Pumpkin

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SUMMARY

The flavor of drum-dried pumpkin powder and its storage properties were investigated. Pure pumpkin powder in pies yielded a flavor equal to that of commercial canned pumpkin. Packed in nitrogen, it could be stored at room temperature for at least one year without undergoing a change in flavor. In an atmosphere of air, it acquired a hay-like off-flavor. Addition of about 25 ppm BHA plus the same amount of BHT was in general less effective against oxidation than was nitrogen packing.

INTRODUCTION

A new method for dehydration of pumpkin on a single-drum dryer was recently developed by Komanowsky *et al.* (1964) at the Eastern Utilization Research and Development Division of the U.S. Department of Agriculture. Cost estimates made by Turkot *et al.* (1965) show that the price of this product compares favorably with that of canned pumpkin.

The study reported in this paper was conducted: 1) to measure consumer reaction to pies made from the new product by comparing them in flavor with pies made from commercial canned pumpkin; and 2) to find packaging conditions adequate for commercial use by studying the effects of nitrogen packing and addition of BHA + BHT on shelf-life.

EXPERIMENTAL METHODS

Preparation of products. Two different products were used: 1) pure pumpkin powder; and 2) pumpkin powder containing 20% potato solids. The former was made by concentrating commercial canned purée at atmospheric pressure to about 21% solids content and applying the concentrate to a single-drum dryer operated at a steam pressure of 75 psig and a speed of 5 rpm. The latter was produced by adding potato solids in the form of potato flakes to concentrated pumpkin purée of about 21% solids content and dehydrating the mixture at a steam pressure of 95 psig and a speed of 7.8 rpm. Other operating details have been described by Komanowsky *et al.* (1964).

Chemical analyses. Moisture analyses were performed by dehydrating 10-g samples of product under vacuum for 6–7 hr at 84°C. The method of Nury *et al.* (1959) was employed for sulfite determination. Headspace oxygen content in the nitrogen-packed cans was measured with a Beckman oxygen analyzer, Model E-2, and the BHA and BHT analyses were performed by the method described by Filipic and Ogg (1960).

Comparison with commercial products. This test was conducted by Dr. Helen Brown, Head, Foods and Nutrition, College of Home Economics, University of Maryland. The product used was pure pumpkin powder packed under nitrogen in hermetically sealed cans containing approximately 1% moisture, 250 ppm sulfite, as well as 25 ppm BHA + 25 ppm BHT. It was compared in pies with two popular commercial brands of plain canned pumpkin (one of them being of the same brand as the starting material used to make the pumpkin powder). All pies were baked according to the following recipe:

2 slightly beaten eggs	¼ teaspoon cloves
1 cup granulated sugar	½ teaspoon salt
1 teaspoon cinnamon	1½ cups water
½ teaspoon ginger	1 cup dry skim milk
½ teaspoon nutmeg	1⅞ cups reconstituted or canned pumpkin

The dehydrated pumpkin was reconstituted by adding 15 fluid oz. of hot water to 2 oz. of pumpkin powder.

Pies made of the three products were presented to a panel composed of 84 judges who were asked to express their opinion of each of the samples on a 9-point hedonic scale described by Peryam and Pilgrim (1957). Presentation was by the single-stimulus method. The tasters were not informed as to the nature of the study other than that it concerned preferences for pumpkin pie.

Storage test. Two dehydrated products were made with a single lot of canned pure pumpkin purée. The first contained 3.58% moisture, 243 ppm sulfite, and 38 ppm BHA plus 23.8 ppm BHT. The other had 2.97% moisture and 396 ppm sulfite but contained no antioxidant. Each of these two products was, in turn, divided into two batches. The first batch was packed in air, and the second in nitrogen in 307 × 409 cans which were hermetically sealed. The nitrogen-packed cans contained 0–1% by volume residual oxygen. Table 1 summarizes the treatments.

Samples from each of the four treatments were periodically reconstituted and used in the above-mentioned pie recipe. Water and skim milk were left out, however. Instead, 1⅔ cups of undiluted evaporated milk was used.

Table 1. Storage treatments.

Treatment no.	Antioxidant	Packaging conditions	Storage conditions
1	BHA + BHT	N_2	dry ice
2	None	N_2	73°F
3	BHA + BHT	Air	73°F
4	None	Air	73°F

Table 2. Mean scores on consumer preference test.

Product	Mean preference score
Commercial canned pumpkin A[a]	5.39
Commercial canned pumpkin B	6.24
Dehydrated pumpkin, USDA	5.50

[a] Same source as dehydrated product.

The pies were made by: 1) mixing the dry ingredients with the reconstituted pumpkin; 2) adding eggs; 3) adding milk; 4) pouring the filling into 9-in.-wide aluminum pie pans; and 5) baking for 55–60 min at 400°F. No crust was used.

A panel of 14–20 tasters participated in the storage test. This panel was composed of members who had been screened for taste acuity for dry whole milk or dehydrated mashed potatoes or both, and had taste panel experience of from two to six years. No special training for pumpkin was given, because of the wide variation in pumpkin varieties. All members also were people who liked pumpkin pie and ordered it at least occasionally.

Each taster received 4 coded pie samples (one from each of the four treatments) in the form of wedges approximately 1 inch in diameter, presented simultaneously in random order. He was asked to rank these samples

according to flavor, using as a guide a fifth sample, which was made from the product of treatment no. 1. The sample closest in flavor to the standard was given a rank of 1, while the sample with the highest amount of off-flavor was given a rank of 4.

A separate storage test using the same four treatments was performed on two products containing 20% potato solids. One of the products contained 35.3 ppm BHA plus 19.7 ppm BHT, while the other contained no antioxidant. Moisture content was approximately 2%, and sulfite content was about 250 ppm.

RESULTS AND DISCUSSION

Comparison with commercial products. Table 2 summarizes the mean preference scores of 84 judges on pies made from pure dehydrated pumpkin and pies from two varieties of commercial canned pumpkin purée. This table was obtained by assigning numerical values from 1–9 to the responses, the more-preferred samples receiving a higher score. Analysis of variance was used to determine whether there was a significant difference between the group of means. The differences in preference, as measured by the mean preference scores, were not significant at the 0.05 level, i.e., the test results indicate that pies made from dehydrated pumpkin were equal to pies made from two brands of commercial canned pumpkin (see Table 3).

Storage properties of pure dehydrated pumpkin. Table 4 lists the mean flavor scores of pies made from pure dehydrated pumpkin after 2, 5½, 8½, and 12 months of storage. For each storage period in this table, the pie closest in flavor to the standard has the lowest average flavor score. The numerical results were analyzed by analysis of variance. *F*-tests for each storage period showed the difference between the mean flavor scores to be significant at the 0.05 level. A mean comparison was therefore made with the multiple-range test proposed by Duncan (1955). The mean flavor scores which were statistically equal have been assigned the same letter in the corresponding rank column of Table 4. After 5½, 8½, and 12 months of storage at room temperature, nitrogen packing without antioxidant gave a product as good as the hidden standard. This standard contained an antioxidant and was packed in nitrogen and stored in dry ice. The efficacy of nitrogen packing of pure pumpkin powder is thus apparent. The samples containing an antioxidant were in no case equal to the standard.

Table 3. Analysis of variance on consumer preference test.

Source	Sum of squares	Degrees of freedom	Variance or mean square	F	Significance level
Whole table	1188	251	4.73	.....	.05
Between samples	26	2	13.00	2.78	n.s.
Residual error	1162	249	4.67	.....	.05

Storage properties of dehydrated pumpkin containing 20% potato solids. Table 5 shows the mean flavor scores obtained for each treatment when pumpkin powder containing 20% potato solids was stored.

In the absence of an antioxidant, air-packed samples were inferior to nitrogen-packed at 5 months, 10 months, and 13 months. Except for the 13-month period (which was inconsistent with the 5- and 10-month periods), nitrogen packing was shown to be superior to an antioxidant. Moreover, after 10 and 13 months the N_2-packed was equal in quality to the hidden standard. Thus, as with pure pumpkin powder, the product containing 20% potato solids can be adequately protected for room-temperature storage for at least a year if packed in N_2.

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Reference to products or companies does not imply endorsement.

Table 4. Comparison of mean scores of pure pumpkin powder after various storage periods.[a]

Treatment	2 months		5½ months		8½ months		12 months	
	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level
1) Hidden standard, N_2, antioxidant, dry ice	1.65	A	2.17	A	1.95	A	1.82	A
2) N_2, 73°F	2.75	B	1.67	A	1.75	A	2.12	AB[b]
3) Air, antioxidant, 73°F	2.40	B C	2.94	B	3.20	B	2.76	BC[c]
4) Air, 73°F	3.20	C	3.22	B	3.10	B	3.29	C

[a] In each column the mean scores which have been assigned the same letter are statistically equal.
[b] The probability that treatment 3 is poorer than treatment 2 is at the 6% level.
[c] The probability that treatment 4 is poorer than treatment 3 is at the 15% level.

Table 5. Comparison of mean scores for pumpkin powder containing 20% potato solids after various storage periods.[a]

Treatment	1 month		5 months		10 months		13 months	
	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level	Mean score	Duncan's test 0.05 level
1) Hidden standard, N_2, antioxidant, dry ice	1.39	A	1.32	A	1.72	A	2.14	A
2) N_2, 73°F	2.94	B	2.19	B	2.17	A	1.93	A
3) Air, antioxidant	3.06	B	2.95	C	2.89	B	2.29	A
4) Air, 73°F	2.61	B	3.58	D	3.22	B	3.64	B

[a] In each column the mean scores which have been assigned the same letter are statistically equal.